

## **LOCKING DEVICE**

### **FIELD OF THE INVENTION**

The present invention broadly concerns locking devices. More particularly, the present invention relates to a locking device such as a padlock or the like. The present invention specifically is directed to a locking device particularly useful for locking trailer hitch couplers.

### **BACKGROUND OF THE INVENTION**

Over the years, there have been numerous variations of locking devices for a multiple of applications. Typically, a locking device is used to secure objects together, whether it be two independent items, a door for an enclosure, or the like. A locking mechanism may be either key actuated wherein a key is used to turn a locking core or are of a combination type wherein a set of disks are manipulated based on a code.

A widely used locking device is known as the padlock. The standard padlock includes a housing containing the lock core and latch elements. A U-shaped shackle extends from the housing with one leg of the U-shaped shackle being pivoted with respect to the housing. When the padlock is in an unlocked state, the shackle may be rotated so that a free end of the shackle may be inserted through openings, around an object, or the like. The shackle is then rotated back to the alignment and compressed into the housing so that the free end becomes latched by the latching structures contained therein.

The prior art padlock works adequately for a number of conventional applications when the span of the objects to be secured is relatively short or when the span can be fitted with a hasp. However, where the span is larger, it is sometimes difficult to employ a traditional padlock due, in part, to the curvature of the shackle. For this reason, some padlocks are provided with a shackle having elongated legs. In most instances, however, it is desirable to create a locking structure that is resistant to tampering or compromise. Since one of the weakest points in a lock is the shackle, it is desirable that the shackle have reduced accessibility when it is used for its designated purpose. Padlocks having these U-shaped shackles may be subjected to compromise however since the elongated dimension of the legs allows access such that the lock may be cut or broken off of the objects which it is to secure.

Another type of locking device related to the padlock may be referred to as a "locking pin". Here, a shackle includes an elongated shaft having a stop portion such as an enlarged head formed at one end and a latching portion opposite the stop portion. A locking head is then releasable and lockably securable to the latch end of the shackle. The locking head carries a lock core and latch elements to engage the latch structure. While such a device is quite useful in covering longer spans, it has the disadvantage in that the two pieces of the lock are separable so that one may readily become misplaced.

One industry wherein a wide variety of locking devices are employed is the towing industry, especially the recreational vehicle towing industry. Here, a trailer vehicle, such as utility trailer, recreational trailer or the like is towed by a tractor vehicle, such as a car or truck. It is necessary to link the tractor vehicle to the trailer vehicle by some form of a tow hitch. Typically, a hitch ball is secured to the tractor vehicle either directly to the frame or by way of a hitch receiver and hitch bar. The trailer vehicle has a tongue that carries a coupler in the form of a hitch ball receiver and a lever like latch is used to secure the hitch ball receiver onto the hitch ball in a releasable manner. In such an arrangement, numerous releasable connections are present and may be subject to compromise and result in the theft of the trailer vehicle. For example, where a hitch receiver and hitch bar are used, removal of the hitch pin that secures them together will allow the trailer vehicle to be removed even though the hitch ball remains in the hitch ball receiver since the tow bar is removed from the hitch receiver. Therefore, the use of locking hitch pins is known. Further, since the lever latch securing the hitch ball receiver to the hitch ball may be used to release the hitch ball, it is known to lock the lever lock or "coupler" to prevent unwanted detachment of the trailer vehicle from the tractor vehicle.

In order to lock the coupler, a conventional padlock may, and commonly is used. However, a substantial portion of the shackle of such a traditional padlock is exposed so that it is not difficult to cut the padlock off of the trailer coupler lever thereby allowing manipulation of the lever either to remove the trailer from the tractor vehicle or to gain access to the hitch ball receiver to attach another tractor vehicle. While pin type locks may be used to lock the trailer hitch coupler lever, these devices are also subject to attack, for example, by a hacksaw, that is used to sever the shaft of the shackle thereby allowing it to be released from the vehicle.

As a result of these disadvantages, there has been a long felt need for better locking mechanisms, especially for use with trailer hitch couplers. There is a need for a locking device that is subject to attack and compromise. There is a further need for locking devices that are more conveniently employed in trailer hitch coupling applications. The present invention is directed to meeting these needs.

### **SUMMARY OF THE INVENTION**

It is an object of the present invention to provide a new and useful locking device which is simple yet sturdy in construction.

It is another object of the present invention to provide a locking device that may be particularly used on trailer hitch couplers.

A further object of the present invention is to provide a locking device wherein the portions thereof may not be disconnected.

Still a further object of the present invention is to provide a key operable locking device having a pleasing, symmetrical appearance.

According to the present invention, then, a locking device is provided that includes a first body member having a first interior and a second body member having a second interior. A retainer element includes a first end portion received in the first interior and a second end portion received in the second interior. Thus, the retainer element mechanically links the first and second body members together for longitudinal movement between a collapsed orientation and an expanded orientation. The retainer element is moveable between a retained position wherein the retainer element secures the first and second body members and the collapsed orientation and a release position wherein the first and second body members may move between the collapsed orientation and the expanded orientation. A lock core is then disposed in the first interior and is operative to engage the retainer element. The lock core has a locked state wherein the retainer element is held in the retain position, but the lock core is moveable to an unlocked state wherein the retainer element is moved from the retain position to the release position. Here, also, the lock core is disclosed to be key actuable.

In the disclosed embodiment, the first body member includes a first housing portion and a first arm portion extending laterally of the first housing portion. Likewise, the second body member includes a second housing portion and a second arm portion extending laterally from the second housing portion. The first and second arms are in opposed relation to one another when the first and second body

members are in the collapsed orientation and the retainer element in the retain position. As disclosed, the first and second arms are in generally parallel spaced-apart relation to one another when the first and second body members are in the collapsed orientation.

A shackle member extends between the first and second body members in order to enclose a locking region when the first and second body members are in the collapsed orientation. In the disclosed embodiment, the shackle is in the form of an elongated shackle post that extends between the first and second arm portions. To this end, one end of the shackle post is secured to one arm and the other arm is provided with a bore that receives a free end of the shackle post when the first and second body members are in the collapsed orientation.

A sealing member is provided to facilitate a seal between the first and second body members when in the collapsed orientation. To this end, also, a protective sleeve may be provided to extend between the first and second body members. The sealing member may be an O-ring and, together with the sleeve, help protect against the ingress of unwanted contaminant materials into the interiors of the housings. At least one of the first and second body members is longitudinally moveable within the sleeve when the first and second body members are moveable between the collapsed and expanded orientations. A cap may be provided to selectively cover the keyway of the locking core.

In the disclosed embodiment, a catch is provided in the second interior, and the retainer element includes a latch portion that is operative to engage the catch when the retainer element is in the retain position and to release from the catch when in the release position. Here, also, the retainer element may include a retaining head that is operative to engage the catch when the first and second body members are in the expanded orientation thereby to prohibit movement of the first and second body members away from one another beyond the expanded orientation. This catch may be defined by a transverse pin, and the latch portion may include a latch groove formed in the retainer element that is sized and adapted to engage the latch pin. The latch portion of the retainer element includes a flat cam face that, in the disclosed embodiment, extends between the latch groove and the retaining head. The flat cam face permits relatively longitudinal movement of the transverse pin and the retainer element between the expanded and collapsed orientations. The retainer element may also include limit stops operative to constrain

movement of the retainer element rotationally between first and second angular positions.

The first and second body members are disclosed to be rotatable with respect to one another about a rotational axis when in the expanded orientation. When in the expanded orientation, the first and second housing portions may be rotated 360° relative to each other about the rotational axis. To this end, the first end portion of the retainer element is rotatably disposed by the retainer axis in the first interior and the second end portion of the retainer element is rotatably disposed about the retainer axis in the second interior. The retainer axis and the rotational axis may be co-axial. The lock core is then rotatably mounted in the first interior such that the lock core rotates when it is moved between the locked and unlocked states thereby to rotate the retainer element between the retain and release positions.

With further detail, the first body member includes a first housing portion with the first arm portion extending laterally thereof. The second body member includes a second housing portion with the second arm portion extending laterally thereof. The first housing portion may include a cylindrical nose projecting longitudinally thereof. The first interior is then defined by a cylindrical nose bore formed in the nose and in communication with a cylindrical core bore formed in the first housing portion. The retaining element includes a base received in the core bore and a shank portion extending longitudinally of the base and received in the nose bore. The retaining element further includes a latch portion projecting longitudinally outwardly of the nose. The lock core is also received in the core bore so that it may engage the retainer. The second interior of the second housing portion has a latch cavity sized and adapted to slideably and rotatably receive the latch portion of the retainer element. The second interior also includes a nose cavity sized and adapted to slideably and rotatably receive the nose of the first housing therein. The second housing portion may terminate in a rim that faces a seat formed on the first housing portion. The O-ring sealing member may then be positioned at the seat whereby, when the first and second body members are in the collapsed orientation, the O-ring engages the rim and the seat.

These and other objects of the present invention will become more readily appreciated and understood from a consideration of the following detailed description of the exemplary embodiments of the present invention when taken together with the accompanying drawings, in which:

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view showing the locking device according to the exemplary embodiment of the present invention attached to the lever actuator of the trailer hitch coupler (shown in phantom);

Figure 2 is a perspective view of a locking device of Figure 1 with the locking device being in a locked state;

Figure 3 is a right side view in elevation of the locking device of Figures 1 and 2 shown in a locked state;

Figure 4 is a left side view in elevation of the locking device of Figures 2 and 3 shown in an unlocked state and with a key therefore being shown in phantom;

Figure 5 is a perspective view of the locking device of Figures 2-4 shown in an unlocked state and with one of the body members thereof rotated with respect to the other body member thereof;

Figure 6 is an exploded side view in partial cross-section showing the elements of the locking device according to the exemplary embodiment of the present invention;

Figure 7 is a side view in elevation of the retainer element shown in a first rotational position;

Figure 8 is a side view in elevation, similar to Figure 7, but showing the retainer element rotated 90 degrees;

Figure 9 is an end view in elevation showing the base of the retainer element of Figures 7 and 8;

Figure 10 is an end view in elevation showing the second body member of the locking device of Figure 6 in order to illustrate the position of the catch pin therein;

Figures 11(a)-11(c) are side views in partial cross-section showing the assembly of the locking device of the present invention in the collapsed orientation and locked state, in the collapsed orientation and unlocked state, and in the expanded orientation and unlocked state;

Figures 12(a) and 12(b) are side views in elevation and in partial cross-section showing a first alternative embodiment of the present invention having a first exemplary anti-rotation structure therewith; and

Figures 13(a) and 13(b) are top plan views of a second alternative embodiment of the present invention having a second exemplary anti-rotation structure associated therewith.

## DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

The present invention broadly concerns locking devices, but it is particularly directed to a mechanical locking device that may be used to secure to objects together. This locking device has particular application to lock the latch lever of a trailer hitch coupler, although it should be understood that the locking device of the present invention is not restricted to such application, but is rather to describe with respect to this application for illustrative purposes only. Thus, the aspects of the present invention may be applied to padlocks in general.

With reference, then, to Figure 1, it may be seen that locking device 10 according to the present invention is shown in a mounted state to a trailer hitch coupler 12 the structure of which is shown in phantom. Trailer hitch coupler 12 includes a hitch ball receiver portion 14 that mounts on a hitch ball. A latch lever 16 is shown in a latched state, but as is understood, without a lock, it is pivotal from the position shown to a 90° orientation to release a latching mechanism associated with the hitch ball receiver portion so that, when in one orientation, a hitch ball may be mated and removed from the hitch ball receiver portion while, in the other position, the latching structure retains the hitch ball in the hitch ball receiving portion.

The locking device 10 illustrated in Figure 1 may be seen in greater detail in Figures 2-4. In Figures 2 and 3, the locking device is shown in the locked state while, in Figure 4, locking device 10 is shown in the unlocked state. In these figures, it may be seen that locking device 10 includes a first body member 20 and a second body member 22 each having a generally tear drop shape. Thus, body member 20 has a first arm 24 extending laterally thereof that is in generally parallel, spaced apart, opposed relation to second arm 26 that extends laterally of second body member 22. An elongated and linear shackle post 28 extends between first body member 20 and second body member 22 and, in particular, between the ends of first arm 24 and second arm 24 so as to define a locking region 30 therein.

With reference to Figures 3-5, it may be seen that first body member 20 and second body member 22 are mechanically linked for movement between a collapsed orientation such as shown in Figure 3 to an expanded orientation such as shown in Figure 4 and 5. Moreover, when in the expanded orientation, they may be relatively rotated about longitudinally extending central rotational axis "A". Also, as is best illustrated in Figure 5, it may be seen that first body member 22 has a lock core 32 disposed therein that, in this embodiment, is key actuable by means of a cylindrical

key 34 (shown in phantom). A protective cap 36 includes a mount in the form of an annular ring 38 which secures a cap portion 40 thereto by means of a hinge piece 42. Cap portion 40 may thus be pivoted between a position wherein it is mounted over lock core 32, as is shown in Figure 2 and 3, to a position wherein lock core 32 is exposed for access by key 34, as illustrated in Figures 4 and 5.

While continued reference may be made to Figures 2-5, the more detailed structure of locking device 10 may be more fully appreciated in reference to Figure 6. Here, it may be seen that first body member 20 has a housing portion 46 that is provided with a cylindrical nose 48 so as to define a seat 50. A circumferential groove 52 extends around nose 48 proximate to seat 50 in order to receive an O-ring 54. First body member 20 and, specifically, housing portion 46 thereof, has an open interior defined by a core chamber 56 and a nose chamber 58 which are in the form of cylindrical bores of different diameters so as to define a first shoulder 59 in the interior of first body member 20. Housing portion 46 also includes a lip 49 opposite nose 48 to form a mount for annular ring 38.

The interior of first body member 20 is sized and adapted to receive a retainer element 60 therein as well as lock core 32. To this end, and with reference also to Figures 7-9, it may be seen that retainer element 60 has a first end portion including a shank 62 and an enlarged base 64 so as to form a rim 66 that abuts shoulder 59 when assembled. A second end portion of retainer element 60 defines a latch portion that extends actually out of nose 48 when assembled, as described in greater detail below. Accordingly, when assembled, base 64 is positioned in core chamber 56 with shank 62 being received in nose chamber 58 for rotation therein.

Likewise, lock core 32 is positioned in core chamber 56 and engages retainer element 60. To this end, lock core 32 includes a casing 68 that may be secured in core chamber 56 by means of press pin 70 extending through bore 72 in first body member 20 such that press pin 70 extends into bore 74 in casing 68. A rotatable core 76 is received in casing 68 and is keyed thereto, as is known in the art so that this structure is not illustrated. Core 76 carries a prong 78 that is adapted to engage slot 80 in base 64 such that, upon rotation of core 76, retainer element 60 will undergo corresponding rotation. With reference to Figures 6 and 9 the amount of relative rotation is controlled by means of a tab 82 formed on lock core 32 and an arcuate slot 84 formed in the edge of base 64. Thus, ends 85 and 86 define



rotational limit stops for retainer element 60 since, at the maximum degrees of rotation, end balls 85 and 86 engage tab 82 to prevent further rotation.

Second body member 22 also has a housing portion 88 with an interior that includes a pair of cylindrical cavities of different diameters. As is illustrated in Figure 6, a latch cavity 90 is sized to rotatably receive the latch portion of retainer element 60 that is defined by latch portion 92 described more thoroughly below. When assembled, nose 48 is received in nose cavity 92 for rotational and sliding movement therein. Further, as may be seen in Figure 6, a second shoulder 94 is formed at the junction of latch cavity 90 and nose cavity 92. Second body member 22 also receives a transverse latch pin 112 which intersects and extends across a portion of latch cavity 90, as is shown in Figure 10, in order to define a catch for the latch portion of retainer element 60.

Shackle 28 may be seen to be an elongated cylindrical post that has a first end with teeth 96 that may be press fit into a bore 98 formed in first arm 24 so that shackle 28 is carried by first arm 24 of first body member 20. A corresponding bore 100 is formed in second arm 26 so that, when first and second body members 20 are moved into the collapsed orientation, free end 102 of shackle 28 engages bore 100.

As noted above, protective cap 36 is provided to protect the keying structure for lock core 32. To further help reduce the likelihood of ingress of unwanted contaminate materials, such as dirt, grease, etc., O-ring 54 is mounted in groove 52. When in the collapsed and locked state, O-ring 54 becomes trapped between seat 50 and rim 104 of head portion 88 of second body member 22. Further, a protective sleeve 106, formed of any suitable plastic material extends between the housing portions. To this end, housing portion 46 of first body member 20 and housing portion 88 of second body member 22 are respectively provided with landings 108 and 110 to receive and engage sleeve 106.

With continued reference to Figure 6, it may be seen that second body member 22 receives a transverse latch pin 112 which intersects and extends across a portion of latch cavity 90, as shown in Figure 10. To this end, latch pin 112 is press fit into a bore 114 that is orthogonal tube that does not intersect rotational axis "A". Latch pin 112 is positioned as a catch to interact with both a latch portion and a retaining head that are disposed on retainer 60.

To this end, the structure of retainer element 60 is illustrated in greater detail in Figure 7-9. Here, it may be seen that retainer element 60 includes a latch portion

116 that includes a circumferential latch groove in the form of a channel 118 that extends at least partially around the circumference of retainer element 60 at a location adjacent to shank 62. Channel 118 is sized so that latch pin 112 may be received tangentially therein. A second channel 122 extends in parallel relationship to channel 118 on an opposite side of rib 120 so as to form a neck 124 with there being a retaining head 126 at an end of retainer element 60 opposite base 64. Retaining head 126 is in the form of a disk shaped plate oriented transversely to the longitudinal rotational axis "L" of retainer 60. A flat cam face 128 extends between retaining head 126 and shank 62, the purpose of which is described in greater detail below.

Having now described the components of locking device 10, the assembly and operation can be appreciated in greater detail with reference to Figures 11(a)-11(c). In these figures, it may be seen that retainer element 60 is mounted in the interior of first body member 20 so that shank 62 is located in nose chamber 58 with base 64 abutting shoulder 59. Latch portion 116 protrudes out of nose chamber 58. Lock core 32 is then positioned in core chamber 56, and it should be understood that tab 82 engages arcuate slot 84 when mounted. Press pin 70 is then placed in position to affix lock core 32 in the interior of first body member 20. O-ring 54 is then positioned in groove 52 and sleeve 106 is mounted either on landing 108 of first body member 20 or on landing 110 of second body member 22. Shackle 28 is pressed fit into bore 98.

At this point, first body member 20 carrying retainer element 60 is mated with second body member 22. To this end, nose 48 is positioned in nose cavity 92 with latch portion 116 projecting outwardly of nose 48 to be positioned in latch cavity 90. End 102 of shackle 28 is mateably inserted into bore 100 in second body member 22. At this point, with lock core 32 being in a locked position, latch pin 112 is inserted in bore 114 so that it extends along side shank 62 in channel 118. After affixing latch pin 112 in the position shown in Figure 11(a), first body member and second body member 22 are locked in a collapsed orientation with shackle member 28 confining locking region 30. Retainer element 60 is in the retain position.

Figure 11(b) illustrates locking device 10 in an unlocked configuration yet in the collapsed orientation. Here, key 34 has been used to rotate the rotatable core of locking core approximately 90 degrees from the locked state to the unlocked state. Due to the engagement of prong 78 with slot 80, this movement rotates retainer

element 60 angularly 90° about a common rotational axis from the retain position to the release position. When this occurs, flat cam face 128 is moved into a parallel orientation with respect to latch pin 112. In this orientation, first body member 20 and second body member 22 can now be moved apart from one another to the expanded orientation shown in Figure 11(c) likewise, the body members may be moved from the expanded orientation shown in Figure 11(c) back to the collapsed orientation shown in Figure 11(b). However, it should be appreciated that the expansion from the collapsed orientation to the expanded orientation may only be made until retaining head 126 comes into abutment with latch pin 112; thus, retaining head 126 interacting with latch pin 112 forms a limit stop for this longitudinal expansion since this abutment prevent further separation of first body member 20 and second body member 22. However, this separation is sufficient so that free end 102 of shackle 28 disengages from bore 100. Moreover, since latch pin 112 is now positioned in channel 122, first body member 20 and second body member 22 may be relatively rotated with respect to one another about common longitudinally extending rotational axis "A", as is illustrated in Figure 5.

With further reference to Figures 11(a)-11(c), it should be appreciated that, when in the collapsed state shown in Figures 11(a) and 11(b), O-ring 54 is compressed between rim 104 of head portion 88 and seat 50 of head portion 46. In this position, also, sleeve 106 extends across gap 130 within which O-ring 54 resides. Upon movement to the expanded orientation shown in Figure 11(c), gap 130 increases in longitudinal dimension but sleeve 106 has sufficient longitudinal extension to still enclose gap 130 thereby to protect the interior of locking device 10 against the ingress of unwanted materials. Cap portion 40 may be snap fit onto lip 49 at any time the actuating key is removed from lock core 32 in order to protect the keyway thereof.

With reference now to Figures 12(a) and 12(b), a second exemplary embodiment of the present invention is depicted. In this embodiment, locking device 210 is provided with an anti-rotation structure that prevents rotation of its body members 220 and 222 in the event that the shackle is severed. This anti-rotation structure is provided by a pair of nubs 225 located on nose 248 that engage a pair of respective locking slots 227 formed in the inner sidewall 289 of housing 288 when the first and second body members 220 and 222 are in the collapsed orientation, as is shown in Figure 12(a). So long as first and second body members 220 and 222

are in the collapsed orientation, they may not be rotated relative to one another due to the locking engagement of these nubs 225 in channels 227. However when first and second body members 220 and 222 are moved apart into the expanded orientation, as shown in Figure 12(b) nubs 225 disengage from channels 227 so that first and second body members 220 and 222 may rotate as described with respect to the first embodiment.

With reference now to Figures 13(a) and 13(b), a third exemplary embodiment of the present invention is depicted. In this embodiment, locking device 310 is provided with an anti-rotation structure that prevents rotation of its body members 320 and 322 in the event that the shackle is severed. This anti-rotation structure is provided by a protrusion 327 located on the outer sidewall 389 of housing 388 that engages a corresponding port 325 when the first and second body members 320 and 322 are in the collapsed orientation, as is shown in Figure 13(a). So long as first and second body members 320 and 322 are in the collapsed orientation, they may not be rotated relative to one another due to the locking engagement of protrusion 327 in port 325. However when first and second body members 320 and 322 are moved apart into the expanded orientation, as shown in Figure 13(b), protrusion 327 disengages from port 325 so that first and second body members 320 and 322 may rotate as described with respect to the first embodiment.

Accordingly, the present invention has been described with some degree of particularity directed to the exemplary embodiments of the present invention. It should be appreciated, though, that the present invention is defined by the following claims construed in light of the prior art so that modifications or changes may be made to the exemplary embodiments of the present invention without departing from the inventive concepts contained herein.